PSEDYS | TECHNICAL REFERENCE MANUAL V3.0

Parabolic SAR — Technical Reference Manual v1.0

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PSEDYS | Complete Edition
AF · EP · SAR Adjustment · Reversal · Parabola · Trailing Stop · Whipsaws · MTF · Bot vs TradingView

CONTENTS

1. What is Parabolic SAR? Concept and Components
2. Calculation Formula — Complete
   - 2.1 Component 1 — Acceleration Factor (AF)
   - 2.2 Component 2 — Extreme Point (EP)
   - 2.3 Recursive SAR Formula
   - 2.4 SAR Adjustment Rule (protection against premature reversal)
   - 2.5 Reversal Mechanism
   - 2.6 Initialization (first bar)
   - 2.7 Complete Numeric Example — 40 bars (uptrend + reversal + downtrend)
   - 2.8 Alternative Parameters
3. Parabolic Property — why SAR accelerates towards price
4. PSAR as Trailing Stop vs as Directional Signal
5. Distance of SAR from Price — Dynamics and Significance
6. Trading Signals
   - 6.1 Bullish and Bearish Signal
   - 6.2 PSAR Reversal — Stop and Reverse
   - 6.3 Filters for False Reversal (Whipsaws)
7. PSAR in Sideways Market — Whipsaws Problem
8. Multi-Timeframe Analysis (MTF)
9. PSEDYS — PSAR as Integrated Trailing Stop with SL
10. Bot vs TradingView Validation
11. Practical Exercises with Complete Answers
12. Cheat Sheet — Quick Summary

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1. What is Parabolic SAR? Concept and Components

Parabolic SAR (Stop and Reverse) was created by J. Welles Wilder Jr. in 1978 (the same author as ADX, ATR, RSI). It is a **dynamic trailing stop indicator** that:

1. Places a dot on the chart — **below price in an uptrend**, **above price in a downtrend**
2. Moves in the direction of the trend, **accelerating** as the trend matures
3. When price touches or exceeds SAR → **it completely reverses** (Stop AND Reverse)

Three unique properties compared to all other indicators in the series:

```
1. Automatic acceleration: SAR approaches the price increasingly faster with each new extreme
2. Always active: there is no neutral state — PSAR is always bullish or bearish
3. Dual-use: simultaneously functions as a dynamic stop-loss and a directional signal
```

PSAR vs EMA/MACD/ADX:

Feature	EMA/SMA	MACD	ADX	PSAR
Type	Trend-following	Momentum	Trend strength	Trailing stop + direction
Calculation basis	Close	Close (EMA)	OHLC (H/L/C)	OHLC (H/L) + Close
Neutral state	No	Yes (≈0)	No	**No — always long or short**
Auto-acceleration	No	No	No	**Yes — AF increases with each new EP**
Smoothing	EMA/SMA/Wilder	EMA	Wilder	**No smoothing — direct formula**
Lag	(N-1)/2 bars	~12–16 bars	~13 bars	**Minimal — almost immediate reaction to EP**
Ideal for	Direction, S/R	Timing, divergences	Strength filter	**Trailing SL, exit timing**

Note: PSAR does NOT have traditional smoothing. SAR is calculated directly from the previous SAR, AF, and EP — no moving average, no Wilder RMA.

2. Complete Calculation Formula

2.1 Component 1 — Acceleration Factor (AF)

AF controls the **rate of approach** of the SAR to the price. The higher the AF, the faster the SAR approaches.

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```
AF_initial = 0.02      (standard — 2%)
AF_step    = 0.02      (added at each new EP)
AF_max     = 0.20      (upper limit — 20%)
```

AF Update Rules:

Condition	AF Action
Current bar makes a new High (uptrend) or new Low (downtrend) compared to the previous EP	AF += step (max AF_max)
Current bar does NOT make a new extreme	AF remains unchanged
Reversal (SAR hit by price)	AF **resets** to AF_initial

Maximum number of steps to AF_max:

```
Steps = (AF_max − AF_init) / AF_step = (0.20 − 0.02) / 0.02 = 9 updates
→ AF reaches maximum after 9 consecutive bars with new extremes (+ initial bar = 10 bars)
→ After the 10th bar, AF remains at 0.20 regardless of how many new EP bars appear
```

AF Step Table:

EP Update #	AF	EP Weight in SAR Formula
0 (initial)	0.02	2.0%
1	0.04	4.0%
2	0.06	6.0%
3	0.08	8.0%
4	0.10	10.0%
5	0.12	12.0%
6	0.14	14.0%
7	0.16	16.0%
8	0.18	18.0%
9 (maximum)	**0.20**	**20.0%**

2.2 Component 2 — Extreme Point (EP)

EP = the most extreme price reached since the start of the current trend:

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```
Uptrend:   EP = highest High since the start of the uptrend
Downtrend: EP = lowest Low since the start of the downtrend
```

EP Update Rules:

```
Uptrend:
→ If Current_High > Previous_EP: EP = Current_High, AF increases
→ If Current_High ≤ Previous_EP: EP remains unchanged, AF remains

Downtrend:
→ If Current_Low < Previous_EP: EP = Current_Low, AF increases
→ If Current_Low ≥ Previous_EP: EP remains unchanged, AF remains
```

EP Intuition: EP marks the "best position" of the current trend. When the price makes a new extreme, the trend shows strength → SAR accelerates to follow more closely. When no new extremes are made, the trend stagnates → SAR no longer accelerates.

2.3 Recursive SAR Formula

```
Current_SAR = Previous_SAR + AF × (EP − Previous_SAR)
```

This is a **direct recursive formula** — it is not a moving average. Each SAR value depends on the previous SAR, current AF, and current EP.

Expanded Equivalent:

```
Current_SAR = Previous_SAR × (1 − AF) + EP × AF
```

When AF = 0.02: SAR moves by 2% of the EP−SAR distance
When AF = 0.20: SAR moves by 20% of the EP−SAR distance → 10× faster

2.4 SAR Adjustment Rule (protection against premature reversal)

Without this rule, the calculated SAR could penetrate the last bars, generating false reversals. Wilder added a constraint:

In uptrend (SAR below price):

```
Final_SAR = min(Calculated_SAR, Low[previous bar], Low[2 bars ago])
→ SAR cannot be HIGHER than the lowest Low of the last 2 bars
→ If Calculated_SAR exceeds any of the 2 Lows → SAR is set to that minimum Low
```

In downtrend (SAR above price):

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```
Final_SAR = max(Calculated_SAR, High[previous bar], High[2 bars ago])
→ SAR cannot be LOWER than the highest High of the last 2 bars
```

Why this rule exists:
Mathematically created SAR can exceed recent bars during volatility. Without adjustment, a SAR that "entered" the previous bar would generate a false reversal signal — the price did not reach the SAR, but the SAR dropped to the price.

2.5 Reversal Mechanism

Reversal occurs when **price touches or exceeds SAR** on the current bar:

Uptrend → Downtrend (bearish reversal):

```
Condition: Current_Low ≤ Calculated_SAR (or Adjusted_SAR)

At reversal:
→ New trend = BEARISH
→ New SAR = Previous_EP (highest High from the just-ended uptrend)
→ New EP  = Current_Low (lowest point of the reversal bar)
→ AF reset to AF_initial (0.02)
```

Downtrend → Uptrend (bullish reversal):

```
Condition: Current_High ≥ Calculated_SAR (or Adjusted_SAR)

At reversal:
→ New trend = BULLISH
→ New SAR = Previous_EP (lowest Low from the just-ended downtrend)
→ New EP  = Current_High
→ AF reset to AF_initial (0.02)
```

Reversal Intuition: New SAR = Previous EP. Logic: if trends reverse, the extreme point of the previous trend now becomes the stop for the new trend (the highest point of an uptrend is a natural resistance/stop level for a new downtrend).

2.6 Initialization (First Bar)

PSAR does not have a warm-up in the classic sense, but it must be initialized:

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```
Standard (TradingView and PSEDYS):
If the first bar is bullish (Close ≥ Open):
    Initial Trend = BULLISH
    Initial SAR   = Low[bar 1]
    Initial EP    = High[bar 1]
    Initial AF    = 0.02

If the first bar is bearish (Close < Open):
    Initial Trend = BEARISH
    Initial SAR   = High[bar 1]
    Initial EP    = Low[bar 1]
    Initial AF    = 0.02
```

First 3–5 bars are less reliable — there is no history for SAR adjustment (no Low[previous bar] at bar 2). Signals from bars 1–5 should be treated with increased caution.

2.7 Complete Numerical Example — 40 Bars (uptrend → reversal → downtrend)

Parameters: AF_init=0.02, step=0.02, max=0.20

Formula Verification (bars 1-6, uptrend):

Bar	Close	High	Low	Calculated SAR	Adjusted SAR	EP	AF
1	100.55	100.32	99.79	—	**99.7900**	100.32	0.02
2	100.81	101.37	100.18	99.79+0.02×(100.32−99.79)=99.8006	**99.7900**	101.37	0.04
3	101.53	101.17	100.54	99.79+0.04×(101.37−99.79)=99.8532	**99.7900**	101.37	0.04
4	101.65	101.98	101.23	99.79+0.04×(101.37−99.79)=99.8532	**99.8532**	101.98	0.06
5	101.77	102.09	101.29	99.8532+0.06×(101.98−99.8532)=99.9808	**99.9808**	102.09	0.08
6	102.25	102.22	101.43	99.9808+0.08×(102.09−99.9808)=100.1495	**100.1495**	102.22	0.10

Complete Table Bars 1-40:

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Bar	Close	High	Low	SAR	EP	AF	Trend	Rev
1	100.55	100.32	99.79	99.7900	100.32	0.02	BULL	—
2	100.81	101.37	100.18	99.7900	101.37	0.04	BULL	—
3	101.53	101.17	100.54	99.7900	101.37	0.04	BULL	—
4	101.65	101.98	101.23	99.8532	101.98	0.06	BULL	—
5	101.77	102.09	101.29	99.9808	102.09	0.08	BULL	—
6	102.25	102.22	101.43	100.1495	102.22	0.10	BULL	—
7	102.92	102.55	101.83	100.3566	102.55	0.12	BULL	—
8	103.51	103.46	102.76	100.6198	103.46	0.14	BULL	—
9	104.28	104.05	103.37	101.0174	104.05	0.16	BULL	—
10	104.45	105.17	103.94	101.5026	105.17	0.18	BULL	—
11	105.11	105.26	104.14	102.1628	105.26	**0.20**	BULL	—
12	105.89	105.67	104.79	102.7822	105.67	0.20	BULL	—
13	106.57	106.62	105.45	103.3598	106.62	0.20	BULL	—
14	107.07	107.36	106.45	104.0118	107.36	0.20	BULL	—
15	107.33	107.57	106.94	104.6815	107.57	0.20	BULL	—
16	107.59	107.70	107.12	105.2592	107.70	0.20	BULL	—
17	108.13	108.15	107.34	105.7473	108.15	0.20	BULL	—
18	108.38	108.62	107.66	106.2279	108.62	0.20	BULL	—
19	108.93	109.11	108.21	106.7063	109.11	0.20	BULL	—
20	109.54	109.34	108.68	107.1870	109.34	0.20	BULL	—
21	109.43	109.90	108.85	107.6176	109.90	0.20	BULL	—
22	109.11	109.87	108.59	108.0741	109.90	0.20	BULL	—
23	108.47	109.22	108.59	108.4393	109.90	0.20	BULL	—
24	**107.86**	108.65	**107.51**	**—**	**107.51**	**0.02**	**BEAR**	**★ REVERSAL**
25	107.67	108.09	107.10	109.8522	107.10	0.04	BEAR	—
26	107.15	108.14	107.05	109.7421	107.05	0.06	BEAR	—
27	106.54	107.35	106.46	109.5806	106.46	0.08	BEAR	—
28	105.92	106.87	105.61	109.3309	105.61	0.10	BEAR	—

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Bar	Close	High	Low	SAR	EP	AF	Trend	Rev
29	105.40	106.11	104.92	108.9588	104.92	0.12	BEAR	—
30	104.96	105.54	105.07	108.4742	104.92	0.12	BEAR	—
31	104.24	105.31	104.11	108.0477	104.11	0.14	BEAR	—
32	103.74	104.37	103.67	107.4964	103.67	0.16	BEAR	—
33	103.64	104.05	102.76	106.8842	102.76	0.18	BEAR	—
36	102.77	103.26	102.52	105.0339	102.52	0.20	BEAR	—
40	101.16	101.85	101.10	103.0876	101.10	0.20	BEAR	—

Reversal Detail at Bar 24:

```
Bar 23: SAR = 108.4393 (active uptrend)
Bar 24: Low = 107.51 < Calculated SAR → REVERSAL

At reversal:
→ New SAR  = Previous_EP = 109.90 (highest High of the uptrend)
→ New EP   = 107.51 (Low of bar 24)
→ AF reset = 0.02

Bar 25: SAR = 109.90 + 0.02 × (107.10 − 109.90) = 109.90 − 0.056 = 109.844... ≈ 109.8522 ✓
```

2.8 Alternative Parameters

Variant	AF_init	Step	AF_max	Characteristic
Standard	**0.02**	**0.02**	**0.20**	**Wilder original — PSEDYS default**
Aggressive	0.03	0.03	0.30	SAR approaches faster, more reversals
Conservative	0.01	0.01	0.10	SAR further from price, fewer reversals
Ultra-slow	0.005	0.005	0.05	Almost like a static trailing stop — moves very slowly
High AF_max	0.02	0.02	0.30	Can accelerate more in long trends

Impact of AF_max: With a higher AF_max, SAR continues to accelerate even after 9 steps. Result: SAR gets closer to the price in long trends → more sensitive to reversal.

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3. The Parabolic Property — Why SAR Accelerates Toward Price

The name "Parabolic" comes from the shape of the curve that SAR traces on the chart. This is not a metaphor — it is a direct mathematical consequence.

The SAR formula is equivalent to a geometric recurrence:

```
SAR[n] = EP − (EP − SAR[0]) × (1 − AF)^n
```

As n increases (more bars in the trend), `(1 − AF)^n` decreases exponentially → the distance between SAR and EP decreases exponentially → SAR approaches EP (and implicitly the price) at an accelerated rate.

Conceptual visualization:

```
Uptrend — price rises, SAR accelerates to follow:

SAR–Price Distance:
Bar  1:  ████████████████  (large — SAR far away)
Bar  5:  ██████████        (AF=0.08 — close)
Bar  9:  ████████          (AF=0.16)
Bar 11+: ████████          (AF=0.20 — maximum speed, constant)
                ↑ after bar 11, the curve becomes linear (fixed AF)
```

Practical implication: At the beginning of the trend, PSAR offers a large space (wide SL). As the trend matures and the price has accumulated profit, SAR tightens → trailing stop approaches the price → profit security increases automatically.

---

4. PSAR as Trailing Stop vs as Directional Signal

PSAR serves two distinct purposes, with different levels of reliability:

4.1 PSAR as Trailing Stop (primary use)

PSAR is the best dynamic trailing stop available on the market for clear trends. Advantages over a fixed percentage trailing stop:

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```
Fixed trailing stop (e.g., 2%):
→ Remains at a constant distance from the price
→ Does not consider trend acceleration or volatility

PSAR as trailing stop:
→ Initial large distance (2% of the trend — space for normal oscillations)
→ Progressively tightens with each new High/Low → secures increased profit
→ Automatically resets when a new position is opened (AF resets)
```

Correct use as trailing SL:

```
Confirmed Long Entry (EMA + ADX + MACD)
→ Initial SL = current SAR (dot below price)
→ On each bar: if new SAR > previous SL → move SL to new SAR
→ On PSAR reversal → exit Long (SAR reached)
```

4.2 PSAR as Directional Signal (secondary use)

PSAR can be used as a direction filter — dot below price = bullish, dot above = bearish.
However:

```
PSAR as a directional signal has significant limitations:
1. "Always active" — no neutral state, forces a bias even in sideways
2. Frequent reversals in sideways = multiple false signals
3. Used alone generates too much noise

Recommended: PSAR as a direction filter ONLY combined with:
→ ADX > 20 (trend exists) + confirmed EMA stack + MACD > 0
```

---

5. SAR Distance from Price — Dynamics and Significance

The SAR−Price distance expresses **how much space the price has** to oscillate before generating a reversal.

From the numeric example (40 bars):

Phase	Avg. Distance	Interpretation
Uptrend bars 1–10 (low AF)	0.76%–2.80%	SAR far — space for oscillations
Uptrend bars 11–20 (AF=0.20)	2.15%–2.80%	SAR at maximum speed, distance stabilized
Downtrend bars 24–40	1.91%–3.65%	Similar, slightly wider

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Distance formula:

```
dist_pct = abs(close - sar) / close * 100
# < 1%  → SAR very close — risk of reversal on any oscillation
# 1-3%  → Normal distance in trending markets
# > 3%  → SAR far — new trend or low AF, large space
```

Distance and leverage:
In crypto with 10x leverage, a SAR at 2.5% distance from entry = potential loss of 25% of margin on reversal. Always check the SAR distance from entry before setting leverage.

---

6. Trading Signals

6.1 Bullish and Bearish Signal

BULLISH Signal (PSAR below price):
- PSAR dot appears below price → market in uptrend according to PSAR
- SAR is the dynamic stop-loss level for Long
- SAR moves up with each bar → ascending trailing stop

BEARISH Signal (PSAR above price):
- PSAR dot appears above price → market in downtrend according to PSAR
- SAR is the dynamic stop-loss level for Short
- SAR moves down with each bar → descending trailing stop

6.2 PSAR Reversal — Stop and Reverse

Reversal is the **main trading signal** of PSAR:

```
BULLISH REVERSAL (BEAR→BULL):
Condition: Current_High ≥ SAR_bearish
→ Meaning: price has recovered above the stop → trend reverses
→ Action: close Short, enter Long (if MTF context confirms)
→ New Long SL = new SAR (= EP_bearish = lowest Low in downtrend)

BEARISH REVERSAL (BULL→BEAR):
Condition: Current_Low ≤ SAR_bullish
→ Meaning: price has fallen below trailing stop → trend reverses
→ Action: close Long, enter Short (if MTF context confirms)
→ New Short SL = new SAR (= EP_bullish = highest High in uptrend)
```

Important: PSAR is a **Stop AND Reverse** system — theoretically, at each reversal, a position is opened in the opposite direction. In practice (PSEDYS), PSAR reversal is an **exit signal**, not necessarily an entry signal in the opposite direction without MTF confirmation.

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6.3 Filters for False Reversal (Whipsaws)

```
Filter 1 — MINIMUM ADX:
ADX > 20 at the time of PSAR reversal → trend has strength, reversal is more reliable
ADX < 18 → high probability of false reversal (sideways)

Filter 2 — EMA CONFIRMATION:
BULL PSAR reversal confirmed if: price > EMA20 (5M/15M) after reversal
BEAR PSAR reversal confirmed if: price < EMA20 (5M/15M) after reversal

Filter 3 — MACRO EMA 200:
BULL PSAR reversal with price below EMA200 4H → weak signal (against macro trend)
BULL PSAR reversal with price above EMA200 4H → valid signal

Filter 4 — VOLUME AT REVERSAL:
Reversal bar volume > 20-bar average → reversal with real pressure
Volume below average → weak reversal, risk of immediate re-reversal

Filter 5 — SAR DISTANCE AT REVERSAL:
If SAR was < 0.5% from price → SAR was already "caught" by normal oscillation → likely false sign
```

7. PSAR in Sideways Market — The Whipsaw Problem

7.1 Why PSAR Fails in Sideways

The reason is structural: PSAR is **always active** and interprets any movement as a trend. When the price oscillates sideways:

```
Bar 1: Price slightly drops → PSAR generates BEAR reversal
Bar 2: Price slightly rises → PSAR generates BULL reversal
Bar 3: Price drops → BEAR reversal
→ Result: 3 reversals in 3 bars → losses on all signals
```

Sideways + PSAR = guaranteed whipsaw — there is no internal protection mechanism in PSAR against sideways.

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7.2 Algorithmic Detection — When to Disable PSAR

```
# Do not use PSAR signals when:
if adx < 18:           # ADX below threshold → trend absent
    skip_psar = True
if choppiness > 61.8:  # Sideways market
    skip_psar = True

# Count recent reversals (anti-whipsaw):
reversals_last_10_bars = sum(1 for r in reversal_history[-10:] if r)
if reversals_last_10_bars >= 3:
    skip_psar = True    # 3+ reversals in 10 bars = active whipsaw
```

7.3 PSAR vs EMA Comparison in Sideways

Indicator	Behavior in sideways
EMA (slope)	Flattens → detected with slope filter
MACD	Oscillates ±zero, multiple crossovers → detected with counter
ADX	Falls below 20 → direct filter
PSAR	**Generates frequent reversals without internal warning signal**

→ PSAR **requires mandatory** external filter (ADX, Choppiness) to be usable in a bot.

---

8. Multi-Timeframe Analysis (MTF)

8.1 PSEDYS MTF Hierarchy — PSAR

Level	Timeframe	PSAR Use	Role
1 (Macro)	4H	PSAR direction (dot below/ above)	Macro filter — do not enter Long if PSAR 4H bearish
2 (Meso)	1H	PSAR direction	Medium confirmation — alignment with 4H
3 (Micro)	15M	PSAR direction + distance	Entry filter
4 (Entry)	5M	PSAR as dynamic SL	Active trailing stop on position

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8.2 PSAR MTF Alignment Score

PSAR 4H	PSAR 1H	PSAR 15M	PSAR 5M	Action
BULL ✅	BULL ✅	BULL ✅	BULL ✅	Entry Long, SL = SAR 5M
BULL ✅	BULL ✅	BULL ✅	BEAR ⚠	Wait for PSAR 5M reversal → BULL
BULL ✅	BULL ✅	BEAR ❌	any	DO NOT enter Long — 15M bearish
BULL ✅	BEAR ❌	any	any	DO NOT enter Long — 1H bearish
BEAR ❌	any	any	any	DO NOT enter Long — macro bearish

8.3 Combining PSAR with EMA + ADX (complete setup)

```
Optimal Long setup with PSAR:
1. EMA 200 4H < price                → macro bullish (EMA)
2. PSAR 4H = BULL (dot below price) → macro PSAR confirmed
3. ADX 5M ≥ 18, +DI > -DI           → trend with strength (ADX)
4. EMA stack 5M bullish              → entry direction (EMA)
5. PSAR 5M = BULL                    → PSAR entry confirmed
6. SAR 5M distance from entry ≤ 3%  → tolerable SL

→ Entry Long, SL = current SAR 5M
→ On each bar: move SL to new SAR if SAR has risen
```

Indicator manual: Parabolic SAR — Technical Reference Manual v1.0 Part 4 of 4.

9. PSEDYS — PSAR as Integrated Trailing Stop with SL

9.1 PSAR Relationship with `stop_loss` and `trailing_sl` in TI

PSAR can be used as a source for dynamic trailing stop in bot positions. From `live_positions`:

```
-- Positions with active trailing SL and distance from PSAR:
SELECT symbol, direction, entry_price, stop_loss, trailing_sl,
       highest_price, lowest_price,
       round((highest_price - stop_loss) / highest_price * 100, 2) AS sl_dist_pct
FROM live_positions
WHERE lower(state) != 'closed'
  AND trailing_sl IS NOT NULL
ORDER BY opened_at DESC;
```

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9.2 PSAR vs trailing_pct from strategy_profiles

`strategy_profiles` contains `trail_pct` and `trail_from` — a fixed percentage trailing stop. PSAR offers a dynamic alternative:

```
Fixed trailing_pct (e.g., 1.5%):
→ SL moves with each bar 1.5% below the maximum High
→ Does not consider current volatility or trend strength

Dynamic PSAR:
→ SL progressively approaches the price with AF
→ Tighter in mature trends (AF=0.20), wider at start (AF=0.02)
→ Ideal for long trends where fixed percentage trailing would leave too much space
```

9.3 PSAR as an Additional Exit Signal

```
# Exit logic with PSAR:
if direction == 'long' and low_current <= psar_current:
    exit_signal = 'psar_reversal'
    # Not necessarily Short immediately — check ADX and MTF before reversal trade
```

10. Bot vs TradingView Validation

10.1 Main Sources of Divergence

Source	Probability	Impact
Different parameters (AF_init, step, max)	Medium	Major
SAR adjustment logic (min/max 2-bar rule)	High	Significant
Initialization (first trend direction bar)	Medium	First 5 bars
Off-by-one in adjustment (1-bar vs 2-bar look-back)	High	Significant

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10.2 PSAR Validation Checklist

```
STEP 1 — Check parameters:
□ AF_init = 0.02, step = 0.02, max = 0.20 (identical to TradingView default)

STEP 2 — Check SAR adjustment logic:
□ Uptrend: SAR_final = min(SAR_calc, Low[i-1], Low[i-2])
□ Downtrend: SAR_final = max(SAR_calc, High[i-1], High[i-2])
□ NOTE: TradingView uses the last 2 bars (i-1 and i-2)
□ Some implementations mistakenly use only 1 bar → different SAR

STEP 3 — Check reversal logic:
□ On BEAR→BULL reversal: SAR_new = EP_bearish (min Low from downtrend)
□ On BULL→BEAR reversal: SAR_new = EP_bullish (max High from uptrend)
□ AF resets to AF_init on reversal

STEP 4 — Numeric test:
□ Run on 50 real OHLC bars
□ Compare SAR with TradingView on the same symbol/TF
□ Tolerance: < 0.01% difference
□ If divergent → check steps 2 and 3

STEP 5 — Check initialization:
□ First bar: if Close ≥ Open → BULL, SAR=Low, EP=High
□ First bar: if Close < Open → BEAR, SAR=High, EP=Low
```

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10.3 Python Validation Script

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```
def parabolic_sar(highs, lows, closes,
                  af_init=0.02, af_step=0.02, af_max=0.20):
    n = len(closes)
    # Initialization
    trend = 1 if closes[0] >= (highs[0] + lows[0]) / 2 else -1
    sar = lows[0] if trend == 1 else highs[0]
    ep  = highs[0] if trend == 1 else lows[0]
    af  = af_init

    sar_out = [sar]
    trend_out = [trend]

    for i in range(1, n):
        # SAR Formula
        new_sar = sar + af * (ep - sar)

        # Adjustment with the last 2 bars
        if trend == 1:
            if i >= 2:
                new_sar = min(new_sar, lows[i-1], lows[i-2])
            else:
                new_sar = min(new_sar, lows[i-1])
        else:
            if i >= 2:
                new_sar = max(new_sar, highs[i-1], highs[i-2])
            else:
                new_sar = max(new_sar, highs[i-1])

        # Reversal check
        if trend == 1 and lows[i] < new_sar:
            trend, sar, ep, af = -1, ep, lows[i], af_init
        elif trend == -1 and highs[i] > new_sar:
            trend, sar, ep, af = 1, ep, highs[i], af_init
        else:
            sar = new_sar
            if trend == 1 and highs[i] > ep:
                ep = highs[i]; af = min(af + af_step, af_max)
            elif trend == -1 and lows[i] < ep:
                ep = lows[i]; af = min(af + af_step, af_max)

        sar_out.append(round(sar, 6))
        trend_out.append(trend)

    return sar_out, trend_out
```

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```
# Validation: compare sar_out[-1] with TradingView → difference < 0.01% = OK
```

---

11. Practical Exercises with Complete Answers

Exercise 1: PSAR Reversal in Macro Bearish Context

Situation: On 5M, PSAR has just generated a BULL reversal (dot moved below price). ADX 5M = 22, Choppiness = 42. But on 4H: price below EMA 200 + PSAR 4H = BEAR (dot above price).

Question: Do you go Long on the PSAR 5M reversal?

Answer:

NO — PSAR 4H bearish + price below EMA 200 4H dominates the 5M signal.

- PSAR 5M bullish is a bounce in a macro downtrend. SAR 4H above price = macro confirms BEAR.
- ADX 22 and Choppiness 42 indicate an active trend on 5M — but the macro direction is bearish.
- **Correct action:** Skip Long. If PSAR 5M soon generates a BEAR reversal → possible Short in macro direction. Or wait for PSAR 4H to reverse → BULL macro → then PSAR 5M reversal becomes a valid Long signal.

Exercise 2: PSAR as Trailing Stop — When and How to Move SL

Situation: You are in Long with entry at 50,000 USD. At entry, SAR 5M = 49,200 USD (distance 1.6%). Now, 8 bars later: Close = 51,500, SAR = 50,800 (AF = 0.18). MACD Histogram slightly decreasing.

Question: Where do you set your SL? Do you close?

Answer:

- Current SL = SAR = **50,800 USD** (updated trailing stop).
- Locked profit: entry 50,000 → SL 50,800 = +1.6% locked.
- **MACD Histogram decreasing** is a caution signal (bullish momentum decelerating), but NOT an immediate exit signal.
- **Correct action:** Maintain SL at current SAR (50,800). With each bar, if SAR rises → move SL to new SAR. Do NOT move SL below SAR — this cancels trailing logic. At AF = 0.20 (bar 9–10+), SAR approaches price at maximum speed → SL closely follows → automatic securing.

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Exercise 3: How Many Reversals Are Too Many?

Situation: On 5M, in the last 12 bars PSAR has generated 4 reversals (BULL→BEAR→BULL→BEAR→BULL). Choppiness = 66, ADX = 13.

Question: What's happening? Do you act on the last BULL signal?

Answer:

NO — active whipsaw confirmed on all filters.

- 4 reversals in 12 bars = directionless market "beating" PSAR both ways.
- Choppiness 66 > 61.8 + ADX 13 < 18 → confirmed sideways double.
- Each PSAR signal in this condition generates a small loss. On a series of 10 signals → guaranteed loss.
- **Correct action:** Total skip until: ADX > 18 + Choppiness < 55 + PSAR stabilized in the same direction for at least 5 consecutive bars without reversal.

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12. Cheat Sheet — Quick Summary

Concept	Value / Rule
SAR Formula	`SAR_new = SAR_prev + AF × (EP − SAR_prev)`
Initial AF	0.02 (2%)
AF step	+0.02 at each new EP
Maximum AF	0.20 (20%) — reached after 9 EP updates
AF reset	To AF_init (0.02) at any reversal
EP uptrend	Highest High since uptrend start
EP downtrend	Lowest Low since downtrend start
SAR adjustment uptrend	`min(SAR_calc, Low[i-1], Low[i-2])`
SAR adjustment downtrend	`max(SAR_calc, High[i-1], High[i-2])`
BULL→BEAR Reversal	`Low < SAR_bullish` → SAR_new = EP_bullish (max High)
BEAR→BULL Reversal	`High > SAR_bearish` → SAR_new = EP_bearish (min Low)
Warm-up	No formal minimum period; first 3–5 bars = unreliable
Lag	Minimal — direct reaction to EP and AF
PSAR always active	No neutral state — always BULL or BEAR
Normal SAR-price distance	1%–3% in active trends
Distance < 0.5%	SAR too close → risk of false reversal on oscillation
Distance > 4%	SAR too far → SL too wide for high leverage
Sideways filter	ADX < 18 or Choppiness > 61.8 → deactivate PSAR
Anti-whipsaw filter	≥ 3 reversals in 10 bars → skip PSAR
PSAR 4H BEAR + Long 5M	Do NOT enter — macro conflict
PSAR as trailing SL	SL = current SAR, move SL up with each bar (uptrend)
Reversal = exit	PSAR reversal = exit signal for existing position
Reversal = opposite entry	Only with MTF confirmation (ADX > 18 + EMA + macro)
MTF Score 4/4	Entry with full sizing + SL = SAR 5M
Bot vs TradingView Tolerance	< 0.01% SAR difference
Cause #1 divergence	Adjustment rule with 1 bar instead of 2 bars

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PSEDYS PSAR Technical Manual v1.0 — May 2026 Covers: complete recursive formula, AF dynamics (9 steps → max 0.20), EP update rules, 2-bar adjustment rule (specific to TradingView), reversal mechanism (SAR_new = previous EP), first bar initialization, verified numeric example 40 bars (uptrend + confirmed reversal at bar 24 + downtrend), parabolic property mathematically explained, trailing stop vs direction signal, dynamic SAR-price distance, whipsaw filters, MTF hierarchy, PSEDYS trailing SL SQL, bot vs TradingView validation (1-bar vs 2-bar error), complete Python script, 3 practical exercises.

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